NATURAL RESOURCE MONITORING PARAMETERS

Dust Storm Magnitude, Duration, and Frequency

Brief Description: The frequency, duration and magnitude (intensity) of dust storms are gauges of the transport of dust and other fine sediments from arid and semi-arid regions [see wind erosion]. Desert winds carry more fine sediment than any other geological agent: the Sahara probably moves 60-200 million tons/yr of dust. An increased flux of dust has been correlated with periods of drier and/or windier climates in arid regions, historically and from proxy records in ocean and ice cores. Material picked up in the Sahara Desert is known to be transported in the atmosphere across the Atlantic Ocean.

Significance: Local, regional and global weather patterns can be strongly influenced by accumulations of dust in the atmosphere. Dust storms remove large quantities of surface sediments and topsoil with nutrients and seeds: in the 1930s, drought and dust storms created the 'Dust Bowl', greatly reducing agricultural production on the North American prairies at that time. Wind-borne dust, especially where the grain size is less than 10 μm, and salts are known hazards to human health. Dust storms are also an important source of nutrients for soils in desert margin areas.

Environment where Applicable: Arid and semi-arid regions, temperate, tropical and sub-tropical latitudes.

Types of Monitoring Sites: Downwind of source areas, near urban and/or agricultural areas, and away from local wind barriers.

Method of Measurement: Determine frequency, length of storm season, volume of transported material, with visibility observations at first-order meteorological stations. Reduction of visibility to WMO specified limits gives an index of event intensity: the duration gives an approximation of magnitude. Satellite measurements of dust storms are being developed for regional monitoring and tracing pathways.

Frequency of Measurement: Each event should be recorded. The best statistic is the annual frequency of occurrence. Estimate long-range sediment transport at least every 10 years.

Limitations of Data and Monitoring: restricted geographical distribution of monitoring sites.

Possible Thresholds: Wind speeds of more than 5-10 m/sec are required for entrainment. Thresholds are strongly affected by the character of the ground surface and the vegetation cover.

Key References:

Goudie, A.S. & N.J.Middleton 1992. The changing frequency of dust storms throughout time. Climatic Change, 20: 97-225.

Lancaster, N. 1996. Geoindicators from desert landforms. In Berger, A.R. & W.J.Iams (eds). Geoindicators: Assessing rapid environmental changes in earth systems:251-268. Rotterdam: A.A. Balkema.

Pye, K. 1987. Aeolian dust and dust deposits. London: Academic Press.

Related Environmental and Geological Issues: Wind erosion, changes in hydrological systems

Overall Assessment: Dust storms can be a major contributor to reduced air quality, and can cause hazards to human health. Their magnitude, duration and frequency are valuable indicators.

Source: This summary of monitoring parameters has been adapted from the Geoindicator Checklist developed by the International Union of Geological Sciences through its Commission on Geological Sciences for Environmental Planning. Geoindicators include 27 earth system processes and phenomena that are liable to change in less than a century in magnitude, direction, or rate to an extent that may be significant for environmental sustainability and ecological health. Geoindicators were developed as tools to assist in integrated assessments of natural environments and ecosystems, as well as for state-of-the-environment reporting. Some general references useful for many geoindicators are listed here:

Berger, A.R. & W.J.Iams (eds.) 1996. Geoindicators: assessing rapid environmental change in earth systems. Rotterdam: Balkema. The scientific and policy background to geoindicators, including the first formal publication of the geoindicator checklist.

Goudie, A. 1990. Geomorphological techniques. Second Edition. London: Allen & Unwin. A comprehensive review of techniques that have been employed in studies of drainage basins, rivers, hillslopes, glaciers and other landforms.

Gregory, K.J. & D.E.Walling (eds) 1987. Human activity and environmental processes. New York: John Wiley. Precipitation; hydrological, coastal and ocean processes; lacustrine systems; slopes and weathering; river channels; permafrost; land subsidence; soil profiles, erosion and conservation; impacts on vegetation and animals; desertification.

Nuhfer, E.B., R.J.Proctor & P.H.Moser 1993. The citizens' guide to geologic hazards. American Institute for Professional Geologists (7828 Vance Drive, Ste 103, Arvada CO 80003, USA). A very useful summary of a wide range of natural hazards.